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(54) A gas turbine engine having means for bleeding compressor air

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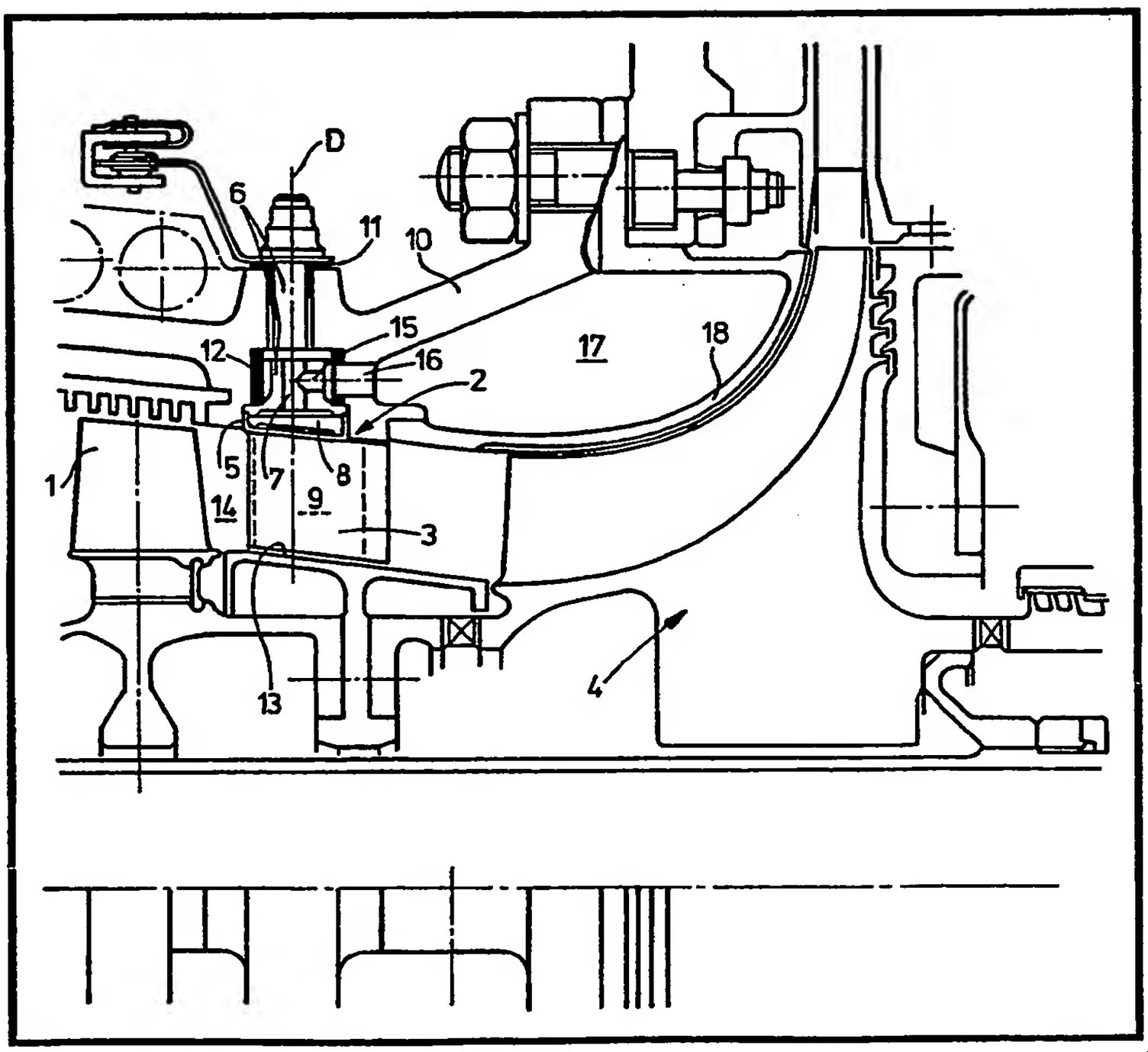
(57) A gas turbine engine comprises an axial-flow compressor having at least one variable guide vane assembly (2), the tips of the guide vanes 3 being disposed adjacent the surface 13 of the rotor, the guide vanes being hollow and being pivotably mounted in the outer casing of the compressor and being arranged so that in use compressor air may be bled from adjacent the rotor surface 13 through the guide vanes (3) and discharged through ducting (7, 15, 16) for subsequent use elsewhere.



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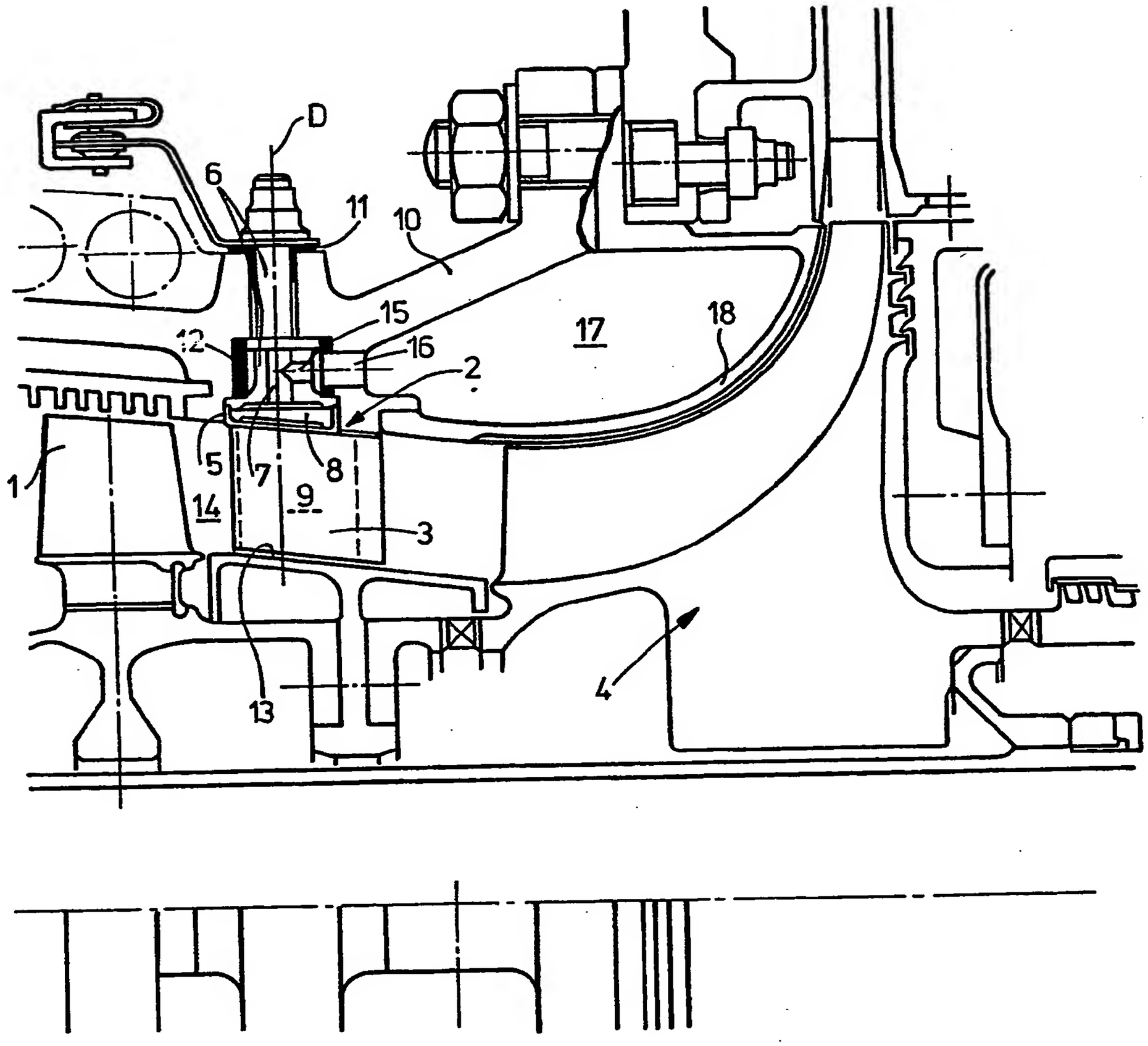

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SPECIFICATION

A gas turbine engine having means for bleeding compressor air

This invention relates to a gas turbine engine having at least one variable axial-flow compressor guide vane cascase and means for bleeding compressor air.

Axial-flow compressors and combined axial-flow centrifugal compressors are frequently fitted with variable guide vane cascades in the front stages to adapt them for service at heavily fluctuating operating condition. It is especially with compressors in gas turbine engines that air must be bled from this compressor area—coming as it does with variable guide vane cascades—for subsequent use both internally and externally of the engine.

It is known to bleed the air from the compressor area fitted with variable guide vane cascades from the radially outer portion of the flow duct, normally *via* holes in the casing wall leading to a collector chamber and from there to a duct. While such air bleeding provisions are advantageous in their simplicity, there is the disadvantage that the centrifugal action of the rotor wheels upstream of the bleed point increases the foreign-body content (e.g. dust, sand, water, hail) in the outer flow portion, which may cause trouble during subsequent use. Furthermore, bleeding the air at the radially-outer portion of the flow duct will neither affect nor eliminate the boundary layer at the hub with its considerable impact on efficiency and operating action of the compressor.

An object of the invention is substantially to overcome the above disadvantages in a simple manner and substantially to eliminate the boundary layer adjacent the hub at the radially-inner wall of the flow duct.

The invention provides a gas turbine engine comprising at least one variable axial-flow compressor guide vane cascade having a hub arranged in a flow duct and a plurality of hollow guide vanes pivotably mounted in an outer casing of the compressor or engine only and being arranged so that in use compressor air may be bled from adjacent the hub through the hollow guide vanes and *via* ducting, for subsequent use elsewhere.

Preferably each guide vane has a turntable and pivot pin through which the bled air flows from the hollow guide vane.

With regard to gas turbine engine guide vanes pivotally supported in the outer casing of the compressor of the engine reference is here made to application DE–PS 10 33 677.

An embodiment of the invention will now be described with reference to the accompanying drawing, which is an elevation view of a combined axial-flow centrifugal compressor of a gas turbine engine.

In the drawing the final axial-flow stage of a compressor has rotor blades 1, and an associated variable guide vane cascade 2 has guide vanes 3. A centrifugal compressor 4 rotates with the portions of the axial-flow section of the compressor.

In this arrangement the aero foils of the guide vanes 3 are a fabricated construction brazed or welded to a cup-shaped turntable 5 likewise made of deep drawn sheet. The assembly of aero foil and turntable 5 is in turn brazed or welded to an associated pivot pin 6 having in its radially-inner portion a cylindrical cavity 7 which communicates with an inner cavity 9 of the associted guide vane 3 through a further cavity 8 of the turntable 5.

The radially-outer, solid portion of the pivot pin 6 serves the function of positioning the guide vane 6 relative to compressor outer casing 10. Sealing members 11 and 12 are inserted between the pivot pin 6 and adjacent portions of the compressor outer casing 10.

The axial-flow section of the compressor has a flow duct 14 having an inner peripheral surface 13. Air is bled from the duct 14 through the ports of the guide vanes 3 facing the inner surface 13, into the respective guide vane cavities 9, and from there the air flows through to the respective cavities 8 and 7 into drilled passages 15 connected with the cavities 7. The passages 15 are arranged at right angles to the axis of rotation D of the guide vanes 3. These drilled passages 15 are followed axially by casing passageways 16 issuing into a collector chamber 17 arranged between portions of the compressor outer casing 10 and a cover plate 18 of the centrifugal compressor. The bled air is ducted from the collector chamber 17 to a consumer through a duct (not shown).

This above-described construction ensures that the bled air is relatively free from foreign matter. Furthermore, the boundary layer at the surface 13 is syphoned away at least partially and this will benefit the downstream areas of the compressor in terms of efficiency and operating action.

The gas turbine engine of the present invention may have a straight axial-flow compressor, having one or several variable guide vane cascades, in which the air is bled at one or several stages of the axial-flow compressor.

CLAIMS

1. A gas turbine engine comprising at least one variable axial-flow compressor guide vane cascade having a hub arranged in a flow duct and a plurality of hollow guide vanes pivotably mounted in an outer casing of the compressor or engine only and being arranged so that in use compressor air may be bled from adjacent the hub through the hollow guide vanes and *via* ducting for subsequent use elsewhere.

2. A gas turbine engine as claimed in claim 1, wherein each guide vane has a

turntable and pivot pin through which the bled air flows from the hollow guide vane.

3. A gas turbine engine as claimed in claim 2, wherein each pivot pin is provided with at least one drilled hole which extends at right angles to the axis of rotation of the pivot pin and connects a cavity of the pivot pin with a passageway in the casing, the passageway issuing into a collector chamber enclosed by casing portions and communicating with means for conveying the bled air for subsequent use elsewhere.

4. A gas turbine engine as claimed in claim 1, 2 or 3 and comprising a combined axial-flow centrifugal compressor.

5. A gas turbine engine substantially as herein described with reference to the accompanying drawing.

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